

Contract No. NA38-37353

Final Report for Period June 25, 1990 to September 30, 1993.

This is the Science-Advisor's Report on USML-1 Project entitled "The Study of Dopant Segregation Behavior During the Growth of GaAs in Microgravity". (Contract No. NA38-38148)

The final phase of the work is under way. Specimens obtained from earth-grown ingots as well as from space-grown (USML-1) ingots of GaAs are being characterized. Preliminary results of the GaAs experiment on USML-1 were reported at the Gordon Research Conference in July and at the Crystal-Growth Conference in Baltimore in August. Further results were reported at USML-1 Review at MSFC in late September, 1993.

Two types of cartridge assemblies are being designed at the moment. One of these will be used for earth-based growth experiments. The other will be used for GaAs crystal-growth experiments on USML-2. Both assemblies will include an electrical interface demarcation system, so that the interface shape throughout the growth process can be determined.

Let me summarize some of my activities during the course of this contract. During the first two years I spent at least one day a week in conference with Dr. David Matthiesen, the Principal Investigator. I participated in the design, fabrication, and assembly of growth ampoules to be used in earth-based and space experiments, and in the determination of the experimental conditions required. I also grew several of the Gallium Arsenide crystals that were used in these experiments. In addition, I trained Matthiesen's assistant in the use of the apparatus, and supervised him until I was satisfied that he had mastered the procedure adequately. I also participated in two of the SIMS exercises for the USML-1 flight. During the subsequent period of the contract I was in frequent communication with Matthiesen on matters concerning results from the USML-1 flight as well as plans for the USML-2 experiments. I also was in Huntsville during the USML-1 flight to participate in monitoring and modifying the the GaAs growth conditions if necessary. I also attended the USML-1 Review at MSFC in September 21-23, 1993 where we discussed the results of the USML-1 results and plans for USML-2.

(NASA-CR-193905) THE STUDY OF  
DOPANT SEGREGATION BEHAVIOR DURING  
THE GROWTH OF GaAs IN MICROGRAVITY  
Final Report, 25 Jun. 1990 - 30  
Sep. 1993 (Viable Systems) 3 p

N94-23549

Unclass

G3/29 0204181

Preliminary results from the USML-1 GaAs crystal growth experiments indicate that some of the growth conditions must be modified for the USML-2 flight. One of the two specimens exhibited voids at the core of the ingot. This indicates that the heat-of-fusion of the crystal could not be dissipated rapidly enough at the growth-rate employed. This condition, aside from producing voids, leads to a concave rather than a planar solid-liquid interface. We should try to come much closer to a planar growth interface on USML-2. If the solid-liquid interface is more than slightly concave, this leads to significant radial segregation, and much of the useful information is compromised. For USML-2 we should extend the GaAs growth period by at least a factor of three in order obtain a planar or nearly planar growth-interface and thus maximize the scientific benefit of the experiment.

  
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1. Report No.		2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle  The Study of Dopant Segregation Behavior during the Growth of GaAs in Microgravity				5. Report Date  11/29/93	
7. Author(s)  James A. Kafalas				6. Performing Organization Code	
9. Performing Organization Name and Address James A. Kafalas Viable Systems, Inc. 99 West Street P.O. Box 439, Medfield, Ma 02052				8. Performing Organization Report No.  20	
12. Sponsoring Agency Name and Address NASA/MSFC  AL 35812				10. Work Unit No.	
				11. Contract or Grant No.  NAS8-37858	
				13. Type of Report and Period Covered FINAL TECHNICAL REPORT 6/25/90 - 9/30/93	
				14. Sponsoring Agency Code	
15. Supplementary Notes					
16. Abstract  Crystal growth experiment to be performed on USML-1. Objective is to determine effect of microgravity growth on dopant segregation.					
17. Key Words (Suggested by Author(s))  Microgravity- Crystal Growth				18. Distribution Statement  Unclassified- Unlimited.	
19. Security Classif. (of this report)		20. Security Classif. (of this page)		21. No. of pages 2	
				22. Price	